

Potential toxicity of the freshwater *Chrysochromulina* species *C. parva* (Prymnesiophyceae)

Lone Reersø Hansen¹, Jørgen Kristiansen^{2,*} & Jørn Vistisen Rasmussen³

¹ Carl Bro A/S, Granskoven 8, 2600 Glostrup, Denmark; ² University of Copenhagen, Botanical Institute, Department of Mycology & Phycology, Ø. Farimagsgade 2 D, 1353 Copenhagen K., Denmark (*author for correspondence); ³ Roskilde Amtskommune, Teknisk Forvaltning, Køgevej 80, 4000 Roskilde, Denmark

Key words: *Chrysochromulina*, Prymnesiophyceae, toxicity, freshwater

Abstract

A mass development of *Chrysochromulina parva* Lackey – 614 000 cells per ml, associated with fish mortality, is reported from a small Danish lake. None of the analyses performed showed any reason for the fish kill. Even oxygen conditions were favourable. Thus toxins from the *Chrysochromulina* might be responsible for the fish kill. If true, this would be the first record of toxicity in a freshwater *Chrysochromulina*.

Introduction

Chrysochromulina is a large genus with about 50 species, almost exclusively marine. Toxic effects have been described from several of these during mass occurrences; especially serious cases have been reported from Scandinavian coasts, caused by *C. polylepis* Manton & Parke (Kaas *et al.*, 1991).

On the other hand, there are very few freshwater species: *C. parva* Lackey (type of the genus), *C. laurentiana* Kling, *C. inornamenta* Wujek & Gardiner, and *C. breviturrita* Nicholls. Of these, *C. parva* is the most common and has been observed almost worldwide (see Diaz & Lorenzo 1991 for references, further Wujek & Saha, 1991), often in mass development, but toxic effects have never been observed. This also holds true for the other species. In some North American lakes, mass occurrences of *C. breviturrita* have been reported to produce obnoxious odours (Nicholls *et al.*, 1982), and hence this species has been under suspicion of being toxic; it has been tested for toxicity, but with negative results.

C. parva has previously been recorded from Denmark, first time in 1969 (Kristiansen, 1971). Originally, it was thought to be characteristic of unstable environments, e.g. gravel pits. Later it has proved to be very common, especially in lakes (for references see Kristiansen, 1991).

Observations

A case of fish mortality occurred in a Danish locality, a small lake in Zealand. Simultaneously, there was an enormous mass development of *Chrysochromulina parva* with little other phytoplankton present, and with no other obvious causes for the fish kill.

The locality, Flaskemosen, is a small lake near Lejre, Central Zealand, with an area of 1 ha. It has five small affluents, and it empties into the river Bregnetved Å. It receives sewage from three houses, surface water from a rain water reservoir, and runoff from fields in the catchment area.

In 1991 on May 18 and 22, and in the begin-

Table 1. Phytoplankton composition, Flaskemosen, 4.6.1991.

	Number of cells per ml
Prymnesiophyceae	
<i>Chrysochromulina parva</i> Lackey	614 000
Xanthophyceae	
<i>Goniochloris mutica</i> (A. Braun) Fott	+
<i>Pseudostaurastrum limneticum</i> (Borge) Chod.	+
Bacillariophyceae	
<i>Asterionella formosa</i> Hass.	+
<i>Cyclotella comta</i> (Ehrenb.) Kütz.	+
Dinophyceae	
<i>Peridinium</i> sp.	+
Chlorophyceae	
<i>Chlamydomonas</i> spp.	8 700
<i>Pediastrum boryanum</i> (Turp.) Menegh.	+
<i>Pediastrum tetras</i> (Ehrenb.) Ralfs	+
<i>Scenedesmus</i> spp. (<i>acuminatus</i> (Lagerheim) Chod., <i>brasiliensis</i> Bohl., <i>opoliensis</i> P. Richt., <i>quadricauda</i> (Turp.) Bréb.)	18 000
Unidentified microalgae	2 400

ning of June, many dead fish were observed, mainly roach, some perch, and a single pike. Further, many living but exhausted roach were seen in the surface, in the act of spawning.

On inspection of the affluents, no signs of pollution were found. On May 22 the oxygen content in the lake was measured to be 13.2–13.5 mg O₂ l⁻¹, temperature 13.8 °C, and pH 8.6. Secchi depth was 1.0 m.

On June 4, in the water, the O₂ content was 14.6–15.3 mg l⁻¹, temperature 14.1–14.2 °C, and pH 8.9. Secchi depth 0.7 m, ammonia (NH₃, NH₄ +) was 8 µg N l⁻¹, and chlorophyll concentration 240 µg l⁻¹.

Pesticides had been used on some of the surrounding fields, but chemical analyses showed no trace of these compounds in the lake water.

Thus, none of the above examinations gave any clue to the understanding of the fish mortality.

An analysis of the Lugol fixed phytoplankton from June 4 (Table 1) showed a rather trivial composition of mainly green algae, but together with an enormous development of *Chrysochromulina parva*, more than 600 000 cells per ml (counted by means of an inverted microscope), which is much more than reported previously from any other place. Lugol fixed material identified by means of electron microscopy (Fig. 1) clearly demonstrated the identity of the species as *C. parva*, unique by its very long, spirally coiled haptonema. Scales were not found in the Lugol

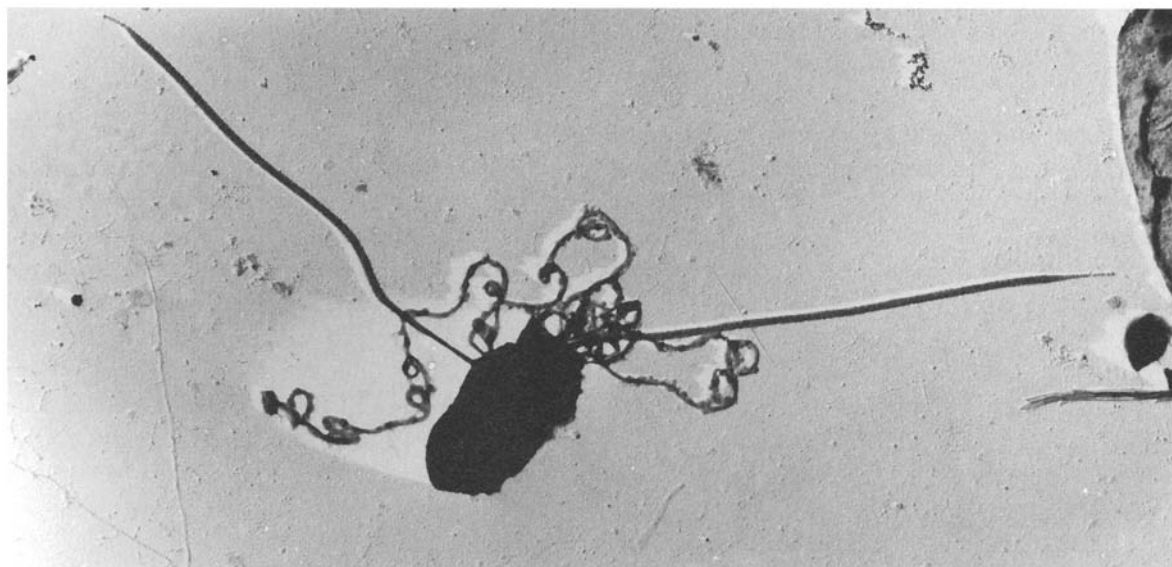


Fig. 1. *Chrysochromulina parva*. Electron micrograph of whole cell from Lugol fixed sample. Flaskemosen 4.6.1991. (6000 ×).

fixed samples; they are best seen in material fixed by means of osmic acid.

Discussion

The mass occurrence of *Chrysochromulina* at the same time as an otherwise unexplained fish kill strongly suggests a toxic effect. No toxicity tests were made, but it is reasonable to suspect that *C. parva* might be toxic. As mentioned, several of the marine species are toxic, in the first line *C. polylepis*, which had massive effects on fish and other animals, and even on benthic macroalgae. It was first observed in mass development, up to 100 000 cells per ml, during the summer 1988 (Kaas *et al.*, 1991).

Previous mass occurrences of *C. parva* without associated fish mortality have been described, but by far not in so high concentrations: 32 000 per ml (Lund, 1961) and 50 000 per ml (Kristiansen, 1971). Its occurrence in spring and early summer is typical, and it can very rapidly develop enormous maxima (Parke *et al.*, 1962; Ito, 1989).

Accordingly, if *C. parva* really proves to be toxic, this is the first report of toxicity in a freshwater *Chrysochromulina*.

References

- Diaz, M. & L. Lorenzo, 1990. *Chrysochromulina parva* Lackey (Prymnesiophyceae) new for South America. *Algological Studies* 60: 19–24.
- Ito, H., 1989. Seasonal fluctuation of *Chrysochromulina parva* (Prymnesiophyceae) in four ponds and lakes in the Kiuki District, Japan. *Sôri. Jap. J. Phycol.* 37: 117–122.
- Kaas, H., J. Larsen, F. Mohlenberg & K. Richardson, 1991. The *Chrysochromulina polylepis* bloom in the Kattegat, Scandinavia, May–June 1988. *Mar. Ecol. Progr. Ser.* 79: 151–161.
- Kristiansen, J., 1971. A Danish find of *Chrysochromulina parva* (Haptophyceae). *Bot. Tidsskr.* 66: 33–37.
- Kristiansen, J., 1991. A Checklist of Danish Freshwater Chrysophytes. Third Ed. Institut for Sporeplanter, University of Copenhagen, 54 pp.
- Lund, J. W. G., 1961. The periodicity of μ -algae in three English lakes. *Verh. int. Ver. Limnol.* 14: 147–154.
- Nicholls, K. H., J. L. Beaver & R. H. Estabrook, 1982. Lake-wide odours in Ontario and New Hampshire caused by *Chrysochromulina breviturrita* Nich. (Prymnesiophyceae). *Hydrobiologia* 96: 91–95.
- Parke, M., J. W. G. Lund & I. Manton, 1962. Observations on the biology and fine structure of the type species of *Chrysochromulina* (*C. parva* Lackey) in the English Lake District. *Arch. Mikrobiol.* 42: 333–352.
- Wujek, D. & L. C. Saha. *Chrysochromulina parva* Lackey (Prymnesiophyceae) a new record from India. *Phykos* 30: 169–171.